I, Catherine E. Pitts hereby swear and affirm that the foregoing direct testimony was prepared by me or under my direct supervision or control and is true and accurate to the best of my knowledge and belief.

Signed: Catherine E. Pitts

Witness

State :
County :

I, Ann C Clark do hereby swear and affirm that

Catherine E. Pitts appeared before me this 20 day of July, 2001.

Signed: Anne C Clark

Ann C. Clark
Notary of S.C.
My Commission expires 11-16-03

Notary Qualification Expires: 11-16-03

[Stamp or Seal]

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Petition of WorldCom, Inc. Pursuant To Section 252 (e)(5) of the Communications Act for Expedited Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes With Verizon Virginia, Inc., and for Expedited Arbitration	)	CC Docket No. 00-218
In the Matter of Petition of Cox Virginia Telecom, Inc. Pursuant to Section 252 (e)(5) of the Communications Act for Preemption Of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia, Inc. and for Arbitration	)	CC Docket No. 00-249
In the Matter of Petition of AT&T Communications Virginia Inc., Pursuant to Section 252 (e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia Corporate Commission Regarding Interconnection Disputes with Verizon Virginia, Inc.	)	CC Docket No. 00-251

DIRECT TESTIMONY OF JOSEPH P. RIOLO

ON BEHALF OF AT&T AND WORLDCOM, INC.

July 31, 2001

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DIRECT TESTIMONY OF JOSEPH P. RIOLO

ON BEHALF OF AT&T[1] AND WORLDCOM, INC.

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[1] This Direct Testimony is presented on behalf of AT&T Communications of Virginia, Inc., TCG Virginia, Inc., ACC National Telecom Corp., MediaOne of Virginia and MediaOne Telecommunications of Virginia, Inc. (together, "AT&T").

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Joseph P. Riolo. I am an independent telecommunications consultant. My business address is 102 Roosevelt Drive, East Norwich, NY 11732.

Q. PLEASE DESCRIBE YOUR QUALIFICATIONS AND EXPERIENCE AS THEY PERTAIN TO THIS PROCEEDING.

A. I have been an independent telecommunications consultant since 1992. As a consultant, I have submitted expert testimony on matters related to telephone plant engineering in California, Delaware, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Virginia, West Virginia, Wisconsin, District of Columbia, and the FCC. I have personally engineered all manners of outside plant including underground, aerial and buried plant in urban, suburban and rural environments. I have engineered copper and fiber plant as well as provisioned analog and digital services. I have participated in the design, development and implementation of methods and procedures relative to engineering planning, maintenance and construction. During the course of my career, I have had opportunities to place cable (both copper and fiber), splice cable (both copper and fiber), install digital loop carrier, test outside plant and perform various installation and maintenance functions. I have prepared and awarded contracts for the procurement of materials. I have audited and performed operational reviews relative to matters of engineering, construction, assignment and repair strategy in each company throughout the original Bell System.

I have directed operations responsible for an annual construction budget of $100 million at New York Telephone Company. My responsibilities included but were not limited to engineering, construction, maintenance, assignment and customer services.

Further detail concerning my education, relevant work experience and qualifications can be found in Exhibit (JPR-1) to this testimony.

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. AT&T and WorldCom, Inc. asked that I review the Outside Plant Engineering assumptions and inputs of the Synthesis Cost model runs that AT&T/WorldCom witness Brian F. Pitkin is sponsoring as evidence of the forward-looking economic costs of providing unbundled network elements ("UNEs") in Virginia.

Q. ARE THE DESIGN ASSUMPTIONS IN THE SYNTHESIS MODEL SIMILAR TO THE STANDARD DESIGN PRACTICES EMPLOYED BY ENGINEERS DESIGNING THE LOCAL NETWORK?

A. Yes. The Synthesis Model models the network in a fashion that is similar to the manner in which outside plant engineers typically design the Local Network. Fundamental to this design is the development of the Long Range Outside Plant Plan. Training courses and practices used to instruct engineers of Incumbent Local Exchange Carriers ("ILEC") such as Verizon provide guidance to the engineer in modeling the network in manageable-sized building blocks, starting at the customer premise and working back towards the Central Office. Each section of the Outside Plant Network is sized according to the capacity requirements of the area served. The Synthesis Model follows a very similar methodology.

III. STEPS IN THE DEVELOPMENT OF AN ILEC OUTSIDE PLANT PLAN

Q. WHAT IS THE INITIAL STEP IN THE DEVELOPMENT OF AN ILEC LONG RANGE OUTSIDE PLANT PLAN, ACCORDING TO GENERALLY ACCEPTED OUTSIDE PLANT ENGINEERING PRINCIPLES?

A. The initial step in the development of an ILEC Outside Plant Plan requires that information be gathered about customer demand, wire center locations and central office boundaries. The next step in the traditional planning process is to cluster customer locations into Distribution Areas. Each Distribution Area has a single interface point to the feeder network, and contains small distribution cables that connect subscribers' homes and businesses to the feeder network over what is commonly referred to as "the last mile." Clustering customers into a Distribution Area allows engineers to input pockets of customer demand into a computerized feeder model.

Q. HOW DOES AN ILEC ENGINEER ACCOUNT FOR THE TRANSMISSION CHARACTERISTICS OF COPPER CABLE WITHIN A DISTRIBUTION AREA?

A. All cables within a Distribution Area should have a uniform cable gauge makeup and transmission characteristics. This traditional simplified engineering planning and design method, also known as "prescription design",[2] has been used for decades because it makes it unnecessary for the engineer to do a manual loop qualification for each individual loop within the Distribution Area.

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2 *See, e.g.*, Telcordia, Telcordia Notes on the Networks, (Oct. 2000), at 12-2, which states: "Distribution plant design treats loops on an aggregate instead of an individual basis, so large composite cross-sections of facilities are designed with similar transmission characteristics. This simplifies distribution network design, especially when several gauges of cable are used."

Q. WHAT ARE THE NEXT STEPS IN THE TRADITIONAL ILEC PLANNING PROCESS FOR OUTSIDE PLANT?

A. The next step is to sectionalize the outside plant feeder structure and cable network.[3] Each ILEC feeder section, called an Exchange Feeder Route Analysis Plan ("EFRAP") section, should have one type of structure and may contain several cables. This sectionalization allows the computer modeling of an outside plant feeder network.

After the ILEC engineer sectionalizes the outside plant feeder structure and cable network, the next step is to connect the requirements of a Distribution Area to the Feeder Cable network.

Q. WHEN DEVELOPING AN ILEC OUTSIDE PLANT PLAN, HOW DO YOU KNOW HOW TO SIZE A COPPER FEEDER CABLE PROPERLY?

A. The size of a copper feeder cable is based on several factors. First, it requires a forecast of demand from the distribution area or areas that the EFRAP section will directly feed. The requirements of the feeder section are increased to accommodate 2 to 5 years of growth. In addition, because cables come in discrete sizes, additional spare cable capacity may be installed in particular sections.

Q. WHAT ARE THE DESIGN GUIDELINES FOR CONNECTING THE FEEDER FACILITIES TO THE DISTRIBUTION CABLES IN THE LOCAL LOOP, AND HOW HAVE THESE GUIDELINES EVOLVED?

A. In the local loop, feeder facilities and distribution cables are connected at a Serving Area Interface ("SAI") or Feeder Distribution Interface ("FDI").

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[3] The term "structure" denotes the medium used to support cable, *i.e.*, cable can be strung on poles, passed through underground conduit or simply buried in soil.

During the early 1960's until approximately 1972, outside plant design guidelines mandated the use of a FDI. The FDI provided a manual cross-connection point between feeder and distribution plant. Compared to "multipled plant" (originally designed for party-line service so that a single cable pair would appear for assignment in several locations; *i.e.*, multiple bridged taps), interfaced plant provides greater flexibility in the network.[4]

In the early 1970's, the Serving Area Concept ("SAC") design was introduced as a prescription simplified engineering planning and design method, and was the first major attempt to modernize the network to care for growing and ubiquitous service to an ever shifting customer base. Under SAC design, the distribution cable network is connected to the feeder network at a single interconnection point, the Serving Area Interface or Feeder Distribution Interface, with no multipled copper feeder cable facilities (*i.e.*, zero bridged tap).[5]

In 1980 the SAC design concept was incorporated into the Carrier Serving Area concept ("CSA").[6]

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4 Telcordia, Telcordia Notes on the Networks, (Oct. 2000), at 12-3, states as follows: "Interfaced plant uses a manual cross-connect and demarcation point, the FDI, between the feeder plant and distribution plant. The cross-connect, or interface, allows any feeder pair to be connected to any distribution pair. This increases flexibility and reduces outside plant deployment and labor costs. Compared to both multiple and dedicated plant, interfaced plant provides greater flexibility in the network and represents the present conventional (metallic pair) distribution plant design philosophy."

5 Bellcore (now known as Telcordia), Telecommunications Transmission Engineering, 1990, at 93.

6 Telcordia, Telcordia Notes on the Networks, (Oct. 2000), at 12-4.

Q. DID THE INTRODUCTION OF CSA DESIGN GUIDELINES AND USE OF DIGITAL LOOP CARRIER SYSTEMS CHANGE THE TRADITIONAL ILEC ENGINEERING PLANNING PROCESS?

A. Yes. Introduction of CSA design guidelines and use of digital loop carrier systems in the feeder portion of the local network changed the engineering planning process. This design change was implemented in 1980.[7] A CSA is a planning entity consisting of a distinct geographic area that can be served by a single Digital Loop Carrier ("DLC") Remote Terminal ("RT") site. The geographic area could encompass a single Distribution Area ("DA") or multiple DAs. The maximum allowable bridged-tap was relaxed from no bridged tap under SAC guidelines to 2,500 feet, with no single bridged-tap longer than 2,000 feet. Also, all CSA loops must be unloaded and should not consist of more than two gauges of cable.[8]

Q. HOW DID THE DIGITAL LOOP CARRIER SYSTEMS CHANGE THE SIZING GUIDELINES USED IN FEEDER ROUTE DESIGN?

A. The use of DLC systems in the feeder route allowed feeder plant to have higher fill ratios, because additional service requirements could be very efficiently addressed by installing additional channel units at the RT site after the initial system was placed into service. Use of DLC systems allows relief to be accomplished in a matter of minutes instead of traditional timeframes required to reinforce copper feeder facilities by engineering and installing additional cables along a feeder route. The accepted engineering guideline for provisioning DLC

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7 *Id.* at 12-3.

8 *Id.* at 12-4.

systems has been to provide enough channel units (plug-ins) to meet the existing service requirements plus 6 months of anticipated growth.

Q. HOW DOES THIS SYNTHESIS MODEL TRANSLATE THESE ENGINEERING PRACTICES INTO AN ESTIMATE OF THE FORWARD LOOKING COSTS OF PROVIDING SERVICE?

A. Exhibits B and C to Mr. Pitkin's Direct Testimony and Exhibit B to the Cost Studies and Supporting Documentation Setting Forth Cost Model Outputs for Unbundled Network Elements and Associated Non-Recurring Charges Submitted by AT&T Communications provide an explanation of how these engineering practices are incorporated into the Synthesis Model.

Q. IS THE SYNTHESIS MODEL GENERALLY CONSISTENT WITH THE FOREGOING PRINCIPLES?

A. Yes. The Synthesis Model inputs and algorithms replicate the planning process. Customer locations and associated service demands are defined in the clustering model; distribution cabling algorithms connect those demands to the feeder cable at an interface (FDI); and the feeder cables are sized and pathed to the appropriate serving central office. Nonetheless, certain modifications should be made to the model to generate more accurate cost data.

IV. MODIFICATIONS THAT ARE NEEDED TO THE SYNTHESIS MODEL PLATFORM

Q. BASED ON YOUR REVIEW, WHAT MODIFICATIONS SHOULD BE MADE TO THE SYNTHESIS MODEL PLATFORM?

A. During my review of the Synthesis Model, I noted several engineering assumptions in the model's algorithms that impact cost and require modification.

Additionally, several input values should be changed to be more reflective of realistic values.

A. MODIFICATIONS TO THE MODEL'S ALGORITHMS

Q. PLEASE IDENTIFY THE ENGINEERING ASSUMPTIONS IN THE MODEL'S ALGORITHMS WHICH REQUIRE MODIFICATION.

A. My review of the model indicates that modifications are required to properly orient drop terminals, select node criteria and account for distribution/feeder sharing.

Q. PLEASE IDENTIFY THE MODIFICATIONS NEEDED TO PROPERLY ORIENT DROP TERMINALS.

A. The Model places the drop terminal locations toward the northeast corner of the microgrid. Thus, in most of the quadrants in the microgrid, the drop terminals are placed away from the serving SAI/FDI. This design requires construction of too much drop cable and is inefficient. I believe the model should be modified as shown in Exhibit D to the testimony of Mr. Pitkin, in order to shift drop terminals toward the SAI/FDI location. This modification would ensure that the Synthesis Model does not place drop terminals beyond the customer location or back-feed the drop to the customer (*i.e.,* use extra cable to serve the customer).

Q. PLEASE IDENTIFY THE MODIFICATIONS NEEDED TO PROPERLY SELECT NODE CRITERIA.

A. The Synthesis Model fails to use the appropriate criteria for connecting nodes in the modified PRIM algorithm. The Synthesis Model contains a Prim algorithm that is used to 1) connect all drop terminals to the serving SAI/FDI and 2) connect all SAIs/FDIs to the serving central office. The FCC modified the Prim algorithm to consider *average* cost, not *distance*, when evaluating which node to connect to the existing network in the sequence. The Model documentation states:

> [t]he second modification of the Prim algorithm is in the rule which is used to attach new nodes to the network. Rather than minimizing the distance from an unattached node to the existing network, the algorithm minimizes the total cost of attaching an unattached node, and of constructing all of the lines that are required to carry traffic from that node back to the central office."[9]

I have found that the FCC's decision to apply the PRIM algorithm based on average cost, rather than distance, causes the model to back-feed portions of the network and produce a less optimal design. Using an average cost methodology to connect nodes causes the Synthesis Model to connect distant, densely populated SAIs/FDIs before closer, less dense SAIs/FDIs. As a result, by focusing on cost and not distance the model builds duplicative plant. The Prim algorithm should be modified to attach nodes to the network based on distance rather than cost because this generally creates the kind of lower-cost network envisioned by the FCC's Synthesis Model. This modification is described in Exhibit D to Mr. Pitkin's testimony.

Q. PLEASE IDENTIFY THE MODIFICATIONS NEEDED TO ACCOUNT FOR DISTRIBUTION/FEEDER STRUCTURE SHARING.

A. Based on my experience engineering outside plant, I know that ILECs often use the same structure to support both distribution and feeder cable where distribution and feeder plant follow a common path, a process known as structure sharing. A common example of structure sharing that may be seen by even a casual observer,

[9] Computer Modeling of the Local Telephone Network, (Oct. 1999), at 12.

involves aerial plant design. Aerial plant design typically prescribes constructing a feeder cable that connects the Central Office to a number of individual Feeder/Distribution Interfaces (FDI's) located along the route to be served. From each of theses FDI's, distribution cable(s) are constructed to connect the customers in the surrounding area (Distribution Area) to the interface and ultimately back to the Central Office. The customers that reside immediately adjacent to this route are served via distribution cables supported by the same poles that support the feeder cables which run to each FDI. Similarly, structure sharing occurs in buried and underground plant. As structure represents a significant cost of doing business, engineers seek opportunities to minimize cost through structure sharing. The Synthesis Model, however, fails to share any structure between its distribution and feeder facilities.

Sharing of structure between feeder and distribution facilities reflects an efficient outside plant design and is particularly appropriate in a forward-looking cost model that is not bound by the restrictions of an ILEC's embedded plant. This was recently recognized by the Kansas Corporation Commission which determined that universal service costs should reflect such sharing. In its order, the Kansas Corporation Commission recognized that "Staff examined the placement of feeder and distribution cable for 14 selected wire centers [and] in every case, at least 40 percent of the feeder routes also included distribution cable. In some wire centers the percentage was much higher." Ultimately, the "Commission [found] Staff's recommendation reasonable and adopt[ed] it for developing the cost of universal service in Kansas. Accordingly, the FCC's default value for feeder structure and placement costs shall be reduced by 40 percent."[10]

My view that such sharing of structure is common is buttressed by the fact that the sharing of distribution and feeder structure has been incorporated into BellSouth's Telecommunications Cost Model, recently produced in Florida Docket No. 990649-TP and in Louisiana Docket No. U-24714-A. In Florida, the feeder and distribution facilities share about 13% of the total route distance produced by the model (5,835 / 45,082 = 12%) and 74% of the feeder route was shared with distribution facilities (5,835 / 7,749 = 74%). Similarly, the Louisiana filing revealed that the feeder and distribution facilities share about 20% of the total route distance produced by the model (8,203 / 41,413 = 20%) and the 74% of the feeder route was shared with distribution facilities (8,203 / 11,093 = 74%). Therefore, according to BellSouth's new model, not accounting for shared feeder and distribution facilities would significantly overstate feeder structure distance and artificially inflate the cost of UNEs. I therefore recommend that the Synthesis Model be adjusted to reflect a 40% reduction in feeder structure costs to reflect this sharing.

[10] Order 16, *In the Matter of Investigation into the Kansas Universal Service Fund (KUSF) Mechanism for the Purpose of Modifying the KUSF and Establishing a Cost-Based Fund*, Dkt. No. 99-GIMT-326-GIT, ¶¶52 and 54 (Kansas Corporation Commission).

B. MODIFICATIONS TO THE MODEL'S DEFAULT VALUES

Q. WHICH INPUT VALUES DO YOU RECOMMEND BE MODIFIED FROM THE FCC DEFAULT VALUES?

A. The default values of the Synthesis Model need to be modified in the following input categories to provide an accurate measure of forward-looking costs: (1) DLC Common Cost and Site Preparation; (2) Line Fill; (3) Structure Mix and (4) Fiber Investment/Fiber Cable.

1. DLC Common Cost And Site Preparation

Q. WHAT CHANGES SHOULD BE MADE TO THE DEFAULT INPUTS OF THE SYNTHESIS MODEL FOR DLC COMMON COST AND SITE PREPARATION?

A. The following changes should be made:

LINE	ITEM	FCC INPUT	RECOMMENDED INPUT
1	A2016	$152,617.43	$107,000.00
2	B2016	$74.98	$77.50
3	A1344	$107,224.92	$88,500.00
4	B1344	$74.98	$77.50
5	A672	$97,443.38	$70,000
6	B672	$74.98	$77.50
7	A96	$23,848.20	$18,300.00
8	B96	$87.30	$100.00
9	A24	$19,881.39	$18,300.00
10	B24	$87.30	$100.00
11	AC96	$23,848.20	$18,300
12	BC96	$87.30	$100.00
13	AC24	$19,881.39	$18,300
14	BC24	$87.30	$100
15	SITE PREP	$11,000	-

Q. WHAT ARE THE FCC INPUTS IN THE ABOVE GRID?

A. The FCC inputs on lines 2, 4, 6, 8, 10, 12 and 14 of the above grid relate to line cards for large and small DLC systems. The FCC inputs on lines 1, 3, 5, 7, 9, 11, and 13 relate to high-density and low-density DLC system common costs. The FCC input on line 15 relates to site preparation.

Q. WHY SHOULD THE FCC INPUTS FOR LINE CARDS BE MODIFIED AS YOU RECOMMEND?

A. As the above grid indicates, the inputs for line cards that I presently recommend are somewhat higher than the FCC inputs for line cards. These higher inputs are based on the results of my research on the cost of line cards.

These line costs, however, may be overstated and, thus, overly conservative. More recent studies suggest that the cost of line cards has declined. For example, a recent market forecast prepared by the RHK company indicates that DLC line cards have an average cost of $52 per line in year 2000, and are projected to decrease in cost by 7 percent per year, to a cost of $42 per line in 2003.[11] The $77.50 and $100 per line card costs I have proposed above exceed these costs by a large margin. Further research on my part may convince me to revise my recommended inputs downward.

Q. WHY SHOULD THE FCC INPUTS FOR DLC COMMON EQUIPMENT COSTS BE MODIFIED AS PROPOSED ABOVE?

A. The FCC inputs relating to DLC common equipment costs for high-density and low-density DLC systems should be modified as recommended because the stated FCC inputs overestimate DLC common equipment costs.

Q. HOW DO THE FCC INPUTS OVERESTIMATE DLC COMMON EQUIPMENT COSTS?

A. The FCC inputs overestimate DLC common equipment costs because the inputs improperly include estimates for line card costs. Line cards are not common equipment. Moreover, as shown above, the Synthesis Model has a separate line item for line cards. The effect of including the line card costs in the DLC common equipment costs, in addition to including them as a separate line item, is to double count the line card costs.

Q. HOW DO YOU KNOW THAT THE FCC INPUTS FOR DLC COMMON EQUIPMENT COSTS IMPROPERLY INCLUDE LINE CARD COSTS?

A. As set forth in the table above, and as explained in detail below, my estimates of DLC common equipment costs are much lower than the FCC inputs for common equipment costs. Indeed, my estimates are so much lower than the FCC inputs for

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[11] RHK, *Access Network Systems: Market Forecast*, (Feb. 29, 2000), at 1-28.

common equipment costs that, unless my estimates can be shown to be wrong – which I do not believe to be the case – the only reasonable conclusion is that the FCC inputs must contain extraneous costs. I believe the extraneous costs to be line card costs.

Q. WHAT SUPPORT DO YOU HAVE FOR THE PROPOSITION THAT THE FCC INPUTS FOR DLC COMMON EQUIPMENT COSTS IMPROPERLY INCLUDE LINE CARD COSTS?

A. As described below, I have performed a check which leads me to believe that the FCC inputs for common equipment costs improperly include line card costs. Specifically, if I add to my estimate of common equipment costs the costs of line cards assuming a 50% line card fill, the total approximates the FCC inputs for common equipment costs alone. These calculations are shown in detail at pages 32-33 below.

Q. IN A PREVIOUS CASE, THE FCC DECLINED TO ACCEPT YOUR ESTIMATE OF DLC COMMON EQUIPMENT COSTS. WHY?

A. I believe the FCC misunderstood my argument on this point. In the previous case, just as here, the ILEC's common cost estimate was higher than the one I proposed. And again, just as here, the common cost data provided by the ILEC improperly included within it line card costs, which both the FCC Synthesis Model and the HAI model treat as separate inputs. Although AT&T pointed out that the ILEC's common cost number was improperly inflated, the FCC apparently believed we were arguing that line card costs should not be counted at all, even as a separate line item. The FCC's confusion is clearly apparent from the language of the Tenth Report and Order:

> 277. AT&T and MCI allege that the contract data overstates the actual costs of DLC equipment and therefore, should not be adopted. AT&T and MCI instead advocate use of the HAI default values. AT&T and MCI argue that the contract costs are not only unsupported by any verifiable evidence but, more importantly, are refuted by the contract information from which they were derived. In support, AT&T and MCI submit an analysis of the DLC cost submissions of Bell Atlantic, BellSouth, and Sprint. In each instance, AT&T and MCI assert that these data demonstrate DLC costs that are far below those proposed by the incumbent LECs and the Commission and that are fully consistent with the HAI default values.
>
> 278. We disagree with AT&T and MCI's analysis. For example, AT&T and MCI claim that information provided by Bell Atlantic shows that total DLC common equipment costs for DLC systems capable of serving 672, 1344, and 2016 lines are similar to, and uniformly less than, the corresponding HAI values. In reaching this conclusion, however, **AT&T and MCI omit the costs for line equipment**. As Bell Atlantic points out, the cost of digital line carrier equipment should include these costs, and we agree.[12]

[12] *Federal-State Joint Board on Universal Service,* Tenth Report and Order, 14 FCC Rcd 20156, 20242-43, ¶¶ 277-278 (1999) (emphasis added) (footnotes omitted).

In fact, we had not omitted line card costs from our overall cost analysis in that case, just as we do not do so here. Indeed, as explained at page 15 above, I recognize that line card costs must be included in the overall analysis. The FCC's previous misunderstanding should not lead to rejection of my common equipment cost estimate here. The Commission can include both reasonable line card costs and reasonable DLC system common costs if it adopts the values as set forth in the grid on page 14.

Q. FOR WHAT KIND OF SYSTEMS DOES THE SYNTHESIS MODEL ESTIMATE COSTS?

A. The Synthesis Model estimates costs for high-density (nominal 672 lines and above) and low-density (nominal 96 lines and below) systems. High-density systems are typically used in urban and suburban areas and low-density systems are typically used in rural and some types of suburban areas.

Q. WHAT ARE YOUR ESTIMATES OF DLC COMMON EQUIPMENT COSTS AND HOW DO THEY COMPARE TO THE FCC INPUTS?

A. My estimates are reflected in the table below. My estimates are based on my experience in purchasing this kind of equipment and are the same as the estimates developed by AT&T engineers and other experts for use in the HAI model.

DLC Common Equipment Costs		
	Recommended inputs	FCC Inputs
2016 Line DLC System	$107,000	$163,617.43
1344 Line DLC System	$88,500	$118,224.92
672 Line DLC System	$70,000	$108,443.38
96/120 Line DLC System	$18,300	23,848.20

Note: All costs include the central office equipment, remote terminal equipment, remote site preparation, and fiber patch panels.

Q. DO YOUR ESTIMATES OF DLC COMMON EQUIPMENT COSTS TAKE INTO ACCOUNT ALL MATERIAL AND LABOR COSTS ASSOCIATED WITH HIGH-DENSITY AND LOW-DENSITY SYSTEMS?

A. Yes. With respect to high-density systems, my estimates take into account the material and labor costs associated with the needed common control bank assembly units, channel bank line cards, fiber optic patch panel and site preparation. With respect to the low-density systems, my estimates take into account the material and labor costs associated with the needed host digital terminal, common control bank units, channel bank extended range cards, fiber optic patch panel and site preparation.

Q. UNDER WHAT STANDARDS DID YOU ASSUME THAT THE DLC EQUIPMENT WOULD BE OPERATED?

A. I assumed that the DLC equipment would be operated under a standard, forward-looking GR-303 integrated DLC system. It is very important, when evaluating any proposed costs for DLC equipment, to review the labor costs involved. Many large telephone companies have relied in the past on simplistic engineering and installation percentage factors that are applied to equipment investment. Use of such factors can be very misleading. For example, good competitive procurement policies may determine that it is much more efficient to pay a little more to have equipment pre-assembled in the factory by a manufacturer, rather than having that equipment installed piece by piece in the field. In such a case, use of an engineering and installation factor as a percent of equipment costs will double count appropriate investments. Pre-assembled equipment is engineered up front, and installation labor in the field is significantly reduced. Use of an installation factor method makes pre-assembled equipment more expensive to engineer and install under such a construct. It is therefore appropriate to develop costs based on disaggregated material costs, along with an estimate of engineering hours and an estimate of installation hours. The following table shows that detailed breakdown:

High Density GR-303 DLC			
Central Office Terminal Common Equipment		**Central Office Terminal Labor**	
SONET Firmware	$7,000	Engineering	$660 (12.0 hrs.)
SONET Transceivers	$4,500	Place Frames & Racks	$165 (3.0 hrs.)
Multiplexer Commons	$2,000	Splice DSX Metallic Cable	$55 (1.0 hr.)
Time Slot Interchanger	$3,500	Place DSX Cross Connections	$28 (0.5 hrs.)
DS-1 Shelf Commons	$500	Connect Alarms, CO Timing & Power	$55 (1.0 hr.)
DSX-1 & Cabling	$800	Place Common Plug Ins (21 ea.)	$28 (0.5 hrs.)
		Turn Up & Test System	$165 (3.0 hrs.)
Subtotal	$18,300	Subtotal	$1,200
Remote Terminal Common Equipment		**Remote Terminal Labor**	
Cabinet	$27,500	Engineering	$1,760 (32.0 hrs.)
SONET Transceivers	$4,500	Place Cabinet	$220 (4.0 hrs.)
Multiplexer Commons	$2,000	Copper Splicing (2 hrs. + 672 pairs @ 400/hr.)	$220 (4.0 hrs.)
Time Slot Interchanger	$3,500	Place Batteries & Turn Up Power	$110 (2 hrs.)
Channel Bank Assemblies	$4,000	Place Common Plug Ins (21 ea.)	$28 (0.5 hrs.)
Channel Bank Assembly Commons	$2,500	Turn Up & Test System	$165 (3.0 hrs.)
Subtotal	$44,000	Subtotal	$2,500
		Total = $66,000	

When the $1,000 cost of a fiber optic patch panel and site preparation cost of $3,000 (discussed at pages 30 and 33 – 35 below) are added to the $66,000 figure calculated above, the result is the cost of $70,000 that I have proposed for common costs for a 672 line DLC system as shown on line 5 of the table on page 14 above.

Q. WHAT ASSUMPTIONS DID YOU MAKE WITH RESPECT TO THE HIGH-DENSITY DLC SYSTEM CONCERNING COMMON CONTROL BANK ASSEMBLY UNITS SERVING REMOTE TERMINAL SITES?

A. The drawing below shows a typical central office DLC equipment bay layout containing four Common Control Bank Assembly Units. Although a single Common Control Bank Assembly Unit normally serves multiple Remote Terminals, I have chosen a conservative approach of having one Common Control Bank Assembly Unit per Large DLC Remote Terminal that can serve up to 2016 POTS lines. As a result, no complaint can be raised that I have assumed a low-quality or low-cost configuration for the system.

DLC costs
Litespan 2000 Central Office Terminals

COMMON CONTROL BANKS THAT HOST REMOTE TERMINALS